

Maureen Corcoran: Good morning. I want you to notice that my title on my presentation differs just a little bit from what you see on the agenda, and I want to make note that it is a preliminary assessment. Recently, one of our technical directors down at ERDC called me into office and said headquarters wants us to do an expensive literature review on vegetation on levees. So, my first thought was, I can't say no to headquarters; that's like saying no to my mother, and my mother's from New York. So, sure, and then my second thought was how difficult can this really be? So, I left the office after telling Dr. Sharp, sure, I'll do it, and I get back to my office minutes later, I look at my email, I have one from Dr. Sharp, and it says, "Did I tell you this has to be done in two weeks?" So, keep that in mind that we have assembled a lot of data, but there still perhaps is more that we need to look at.

First, I'd like to recognize my colleagues that helped with this literature assessment. Pam Bailey is a botanist at our environmental lab at ERDC; Charlie Little and Freddie Pinkard -- and I have to apologize, Jim Leach, I left his name out, and he's the only one here of the group that is here to support me. I'm sorry Jim. And they're hydraulic engineers. I'm a geologist and as we say in the South, none of us have a dog in this race. So, we are presenting this in an unbiased format.

The objective of the literature review is to collect and summarize the literature that's pertinent to vegetation on levees and to identify data gaps as defined in the reviewed literature. Now, with the literature review, like I said, we wanted to do an extensive review, an extensive data gathering. So, of course, that everybody's heard today, we look toward the guidance in government documents, and of course journal articles, the proceedings and transactions, newspaper articles, Gray literature, which of course, in the scientific community that usually does mean the government documents. But thanks to the worldwide web, everybody has access to those today.

So, really we included memorandums that you find that for some reason would appear in different formats, but not something that's easy for the public to access. And also personal communication, and by that I don't mean the people that came by my office - and believe me, there were plenty - that had an opinion on this. But these were emails that I received that I felt came from people with experience in this area that I did want to include. Well, unfortunately, as they say, the book is better than the movie, so in this case the document is better than the presentation. I can really not do justice to the document that we reviewed. So, look forward to the book coming out.

Well, when we started getting into this, we realized that we had to come up with different considerations when we were reviewing the literature. We've heard about some of these already this morning; from Dr. Berry, we have to include all types of vegetation, and that includes brush, grasses, trees, the different types, and understand each document and report's research focus and objectives. Also to identify the soil properties, any observations, recommendations that the researcher had made. And here comes the clincher: we had to separate the literature that deals directly with vegetation on levees from literature that may offer an insight or provide us a background, but perhaps did not focus just on levee vegetation.

Well, - and I warn you, I may sigh a lot during this - of course, with a standard format on a literature review, you usually have the title and the abstract. Well, because I thought, we're dealing with so many documents, how can we let the person know that we're trying to get this across to to give them a faster look instead of doing the abstract? So, I thought, okay, let's pull out the objectives, the methodology, the soil properties, the study location, the results, the recommendations, and put those in our literature review. Obviously I don't have much life outside of ERDC. Then also we needed to note that perhaps the newspaper articles did not pull as much weight, or maybe should not be given as much weight as a

peer-reviewed journal article. So, we also make note that when a journal article or document is peer-reviewed.

So, we came up with this really neat coding system, and at first, I thought, I'll make it simple; I'll come up with a two-letter coding system. Well, unfortunately, that made bank stabilization BS. So, I had to extend that a little bit more to come up with a better code. As you can see, we have more letters. Well, this is some information that we did not really use in our assessment, but if the research continues - which I really believe and hope it will - these are documents that are out there that we already have that are going to be very useful to this research. Well, for levee veg, we gathered those documents, well still, it included so many documents that perhaps did not answer the issue that we were looking for. So, then, we included the P for pertinent documents.

To give you a little bit of an idea, we reviewed close to 200 documents, and I think we have about 140 that are actually in the literature review. From that, we only had about 18 that were what we felt were pertinent literature documents that dealt with vegetation on levees. Also, keep in mind that we're looking at 18 documents, but eight of those documents may be from the same research. We may have research that was published in one journal that was also published in several proceedings. So, what it narrows down to, we really don't have that much information on the issue that we're looking at.

Well, I'm not going to cover, like I said, the guidance documents which you've heard a lot about this morning from Dave and others. But I would like to point out some of the international guidance documents that we were able to acquire. One from the United Kingdom in 2003 is "Environmental Options for River Maintenance Work," and when we called Dr. Colin Thorne with the University of Nottingham to see if he had any such document - he's fluvial geomorphologist, very well-published in that area - we mentioned that, gosh, Colin, we're having a little bit of

trouble finding literature to vegetation on levees. Well, his answer kind of said it all. He said, "It's not supposed to be here." I can't do an English accent, but it's much better than that.

So, I thought okay, point taken. From Japan, we were able to acquire a manual for river works in Japan. We don't have a date on that, but there is a section 5.2, Aforestation of Rivers, and that was listed as a draft document. So, apparently there is another report that perhaps exists that we don't have our hands on yet. You will hear this afternoon from the Netherlands and also from the German documents; I'm not going to cover those. My Chinese is a little scratchy now, so we weren't able to translate the article that we have, but we're hoping to do so.

Let me move on to the UK guidelines. They used what they refer to as environmental options, or EOs, to address the vegetation and environmental concerns on embankments, and they go through a little process - or I should say a well-thought out process - where they take these EOs, which are a series of cross-sections and long-section drawings that provide a visual picture of the desired environmental outcome. And they balance each EO with the flood defense needs of the water course, keeping in mind that the flood protection, of course, is the primary objective of the area, and the safety issues with that. They have an area called the Flood Defense Operation, and I'm sorry but I had to spell defense like we do in America; I chance the C to the S. They had the Flood Defense Operation that actually decides the standards required, but then when they agree on that, they meet the standards with what's called the FRB team, or the Fisheries, Recreation, and Biodiversity team.

I have a few examples from their guidelines, and this is their EO on the raised flood embankment. And as you can see, on the bottom of it they say "All trees and bushes removed from embankment." Now, keep in mind that, of course, some trees do grow - do grow, I'm sure, at a very fast rate - so they are faced with the fact that some trees have grown on

these embankments, and now what do they do? So, they look at the trees, and if they're over 25 centimeters - and any branches too - they are trimmed or cut. But anytime a habitat, like an otter hole or a bat habitat is encountered during this time, the FRB team is called in and they reevaluate the EO.

Now, the Japanese guidelines, I don't have the photos from this, but they do believe that aforestation is allowed, which of course is the replanting of trees and vegetation, it is allowed as long as it does not obstruct river control measures. Well, that doesn't give any definite information on that, but in other words they do not allow trees if they influence the primary purpose of the dikes and levees. And also, there is a list available in the manual where they have listed the types of trees and shrubs and vegetation that they do allow to grow on their levees and dikes.

Well, when I was trying to come up with a way to present this to you all today, I have to say, I probably did four different presentations to come up with the best way to present this. So, I decided that probably doing this in a chronological order may be the best. I didn't want to put a lot of information on each document, so I pulled out what we did in our literature review - or some of it, a subset - where we listed the objectives and some methodology and recommendations. Well, one in 1967, a pilot levee maintenance study, the objective was to test for alternate methods of levee maintenance. They did realize that the trees and shrubs were allowed in open patterns, something that was seen earlier by Dr. Gray, I believe, and the recommendation is that the timely repair of any erosion and berms can head off any major reconstruction work, such as removal of vegetation.

In 1984, the role of vegetation in integrated pest management approach to levee management, brings to us an environmental aspect of it, and that is to keep in mind that the sensitive habitat of different plants and animals and to incorporate these into our levee maintenance program. This is

similar, I believe, to what the EOs are with the UK guideline. In 1987, the environmental consideration for levees was really a data review on existing guidelines of the U.S. Corps of Engineers, and they left us with some very good questions. Can current levee maintenance standards be revised to allow more woody vegetation without increasing hazard? And of course, that is the million dollar question and why we all are here today.

And this one you've heard of in every presentation that's been given today, and that's the famous REMA report, 1991, by Dr. Gray and others. The objective was to investigate the relationship between the vegetation and structural integrity of the river levees. And at the time, they did state that the U.S. ACE guidelines were adequate based on the lack of science. Well, on the conclusion that they found, that Dr. Gray did mention in the previous presentation, was that it appears that woody vegetation does not adversely affect the structural integrity of the levee.

But they do point out, too, that their study does not include other aspects such as flood fighting and inspection. And also in the recommendations from the REMA report, they had some very good research, and with good research you always have future recommendations. And that is to conduct similar field studies in levees made of cohesive soils. Their study was conducted in Sacramento, where most of it is sandy levees. Well, down by the river levees on the Mississippi River, we have a lot of clay and a lot of silt, so a different type of material altogether. And also to conduct studies in regions where climatic conditions are different.

In 2007, we've talked about Katrina quite a bit; there was a document that did analyze tree root extending behavior along the levees and flood walls in the New Orleans district. They did collect data through root extensions, from photographs and doing root profile wall mapping, which was discussed by Dr. Berry and Dr. Gray. They did say that while the root may bind the soil together, reducing erosion, that overturning trees may

accelerate the loss of levee integrity. So, they still leave us with some questions; does root extension change when encountering a levee? Their recommendation also was to develop a physical model to do a more in-depth study of this.

On the data gaps, we do recognize that further research to recognize the interaction of vegetation with individual components of the levee is needed, and to address levees not as an entire unit, but as separate environmental communities and establish specific yet different guidance for these areas. And also to extend future research to a system-wide -- and what we mean by system-wide in this note is that the levee system is not just the levees. We have the slurry walls, the pump houses and everything, and also the communities. We have the river communities, channel communities -- to recognize all those and to connect those scientifically, and to answer the questions that we're asking today and during this symposium. And that's all I have.